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~~SOLID BOWL HELICAL CONVEYOR CENTRIFUGE COMPRISING AN ADJUSTABLE OUTLET FOR SOLIDS~~

BACKGROUND

[0001] The ~~invention~~ present disclosure relates to a solid bowl helical conveyor centrifuge ~~according to the preamble of Claim 1~~ including a rotatable drum having a horizontally-oriented axis of rotation. Also included is a rotatable screw arranged in the rotatable drum and at least one discharge opening oriented at an angle with respect to the horizontally-oriented axis of rotation. The at least one discharge opening is configured to discharge solids from the rotatable drum. An adjusting device is assigned to the at least one discharge opening by which adjusting device an outlet cross-section of the at least one discharge opening is changeable. The adjusting device includes a movable adjusting disk arranged in the rotatable drum as an extension of the rotatable screw and which movable adjusting disk is non-rotatably connected with one or more of the following: a) the rotatable drum, b) the rotatable screw, and c) a screw body.

[0002] From German Patent Document DE 43 20 265 A1, a solid bowl helical conveyor centrifuge is known which is provided with a weir on the liquid outlet side which has a passage to which an orifice plate is assigned which, during the rotation of the drum, stands still relative to the latter and which, in turn, is axially displaceable by way of a threaded bush. By ~~means of the~~ rotation of the threaded bush, the distance between the weir and the orifice plate can be changed. The resulting change of the discharge cross-section causes a change of the liquid level in the centrifugal drum, so that a continuous adjustment of this liquid level is permitted by the displacement of the orifice plate. However, an adjustment of the discharge of the solids cannot take place.

[0003] From European Patent Document EP 0 747 127 B1, it is known to arrange a particularly radially adjustable flow regulating element between worm or screw channels in the conical area of the worm. In this case, a relatively long adjusting path has to be bridged in order to implement a change of the outlet cross-section for the solids.

[0004] In contrast, German Patent Document DE 41 19 003 A1, in turn, shows a type of adjustable disk in the transition between the cone and the cylindrical area of the drum and the worm. The adjustment takes place through the worm. The function is that of a baffle plate which also influences the liquid level in the drum.

[0005] From European Patent EP 0 565 268 A1, it is known to provide worm channels only in the cylindrical part of a worm body and to place a type of retaining disk at the axial end of the worm body. Among other things, it is a problem that a worm or screw construction has to be selected which basically differs from conventional worm constructions.

[0006] From European Patent Document EP 0 798 045 A1, it is known to assign a throughput control device to the discharge opening for the solids. This device is arranged at the exterior side of the drum shell, which is to permit an easy visual inspection of the throughput control device. However, the implementation of the adjustability of the throughput control device at the exterior side of the drum rotating during the operation is relatively problematic because it is not close to the center but has to be implemented on a relatively large diameter where the peripheral speed is relatively high.

[0007] With respect to the prior art, Japanese Patent Documents JP 2002 153771A and JP 2003 153772A a well as German Patent Documents DE 41 19 033 A1 and DE 39 21 327 A1 are also ~~mentioned~~known.

[0008] A centrifuge ~~according to the invention~~ is also known from German Patent Document DE 1 823 269. In this document, the non-existent adjustability of the adjusting cone as well as the adjusting device of Figure 2 by way of a torsional nut from the outside, which requires very high constructional expenditures and is relatively complicated, are ~~disadvantages~~ problems of some embodiments. An automatic adjusting of the adjusting cone against a spring is also disclosed which, however, in practice does not lead to satisfactory results.

[0009] ~~It is a task of the invention to eliminate this problem.~~The present disclosure relates to a centrifuge that addresses problems referred to above.

SUMMARY

[00010] ~~The invention achieves this task by means of the object of Claim 1.~~The present disclosure thus relates to a solid bowl helical conveyor centrifuge including a rotatable

drum having a horizontally-oriented axis of rotation. Also included is a rotatable screw arranged in the rotatable drum and at least one discharge opening oriented at an angle with respect to the horizontally-oriented axis of rotation. The at least one discharge opening is configured to discharge solids from the rotatable drum. An adjusting device is assigned to the at least one discharge opening by which adjusting device an outlet cross-section of the at least one discharge opening is changeable. The adjusting device includes a movable adjusting disk arranged in the rotatable drum as an extension of the rotatable screw and which movable adjusting disk is non-rotatably connected with one or more of the following: a) the rotatable drum, b) the rotatable screw, and c) a screw body. Further included is at least one connecting rod fastened to the movable adjusting disk.

[00011] Accordingly, at least one or more connecting ~~rod(s) is/are~~rods are fastened to the adjusting disk which, while the construction is simple, ~~allow~~ allows an uncomplicated operation or an adjusting of the adjusting disk from the outside.

[00012] The non-rotatable connection of the adjusting disk with the ~~worm~~ screw or its ~~worm~~ screw body ~~and~~ , the arrangement as an axial extension of the ~~worm~~ screw ~~as well as~~, and ~~the~~ a selected method of operation ~~surprisingly~~ permit ~~in a simple manner~~, for example, "through the ~~worm~~ screw body", [[(]]or possibly through the drum,[[)]] an adjustability of the cross-section of the at least one ~~(~~, or more~~)~~, discharge opening(s) for the solids. Furthermore, the ~~worm~~ screw body may have ~~worm~~ screw channels in ~~the~~ a cylindrical section as well as in ~~the~~, for example, a conically tapering section.

[00013] ~~In the constructively simplest manner, the~~The connecting rods ~~(~~, in the sense of displaceable pressure and tension rods~~)~~ , permit the operating of the adjusting disk without ~~the~~ a requirement of implementing an adjusting rotating movement.

[00014] By ~~means of the arrangement "as~~ an extension[[~~"~~]]of the ~~worm - particularly~~ screw, as an extension of the conical section of the worm [[-]], it becomes~~, in turn, also~~ possible to arrange the adjusting disk and its adjusting unit ~~particularly~~ close to the center. ~~In this case, it~~It is also conceivable to lead ~~the~~ adjusting forces, for example, by ~~means of~~ the connecting rods, close to the center through the drum, although the arrangement in the ~~worm~~ screw or its drive shaft ~~is particularly advantageous and~~ permits an arrangement which is ~~particularly~~ close to the center.

[00015] ~~By means of the invention~~In accordance with the present disclosure, relatively short adjusting paths can also be implemented for changing the outlet cross-section. The adjustment takes place, for example, as a function of the TS (DS) content~~(~~, or dry substance~~)~~, of the solids (,whose determination is known ~~per se and does not have to be explained here in detail~~).

[00016] ~~Preferably, the~~The adjusting disk [[(]]which~~, in turn, may preferably~~may be constructed to be ~~"plane"~~planar or flat ~~but does not have to be),~~ is axially displaceably arranged in the drum. ~~In this case, it~~The adjusting disk may also be swivellable.

[00017] The adjusting disk ~~is preferably~~may be oriented completely perpendicularly or radially with respect to the axis of rotation of the drum.

[00018] ~~In a particularly preferable and simple manner, the~~An end of the connecting rod facing away from the adjusting disk is directly or indirectly connected with a rod or a pipe, which centrically penetrates an inlet pipe in the axis of rotation of the solid bowl helical conveyor centrifuge. ~~Here, the~~The connecting rod can be constructed as a part which does not go along in the rotation and can be housed in ~~a particularly~~an uncomplicated manner.

[00019] The axial displaceability can ~~relatively easily~~ be implemented by ~~means of~~ an electromotively operable adjusting or driving unit or a hydraulic or pneumatic device through the ~~worm~~ screw body, particularly when these act upon the connecting rod which is fastened to the adjusting disk and which penetrates the axial end of the ~~worm~~ screw body of the ~~worm~~ screw axially adjoining the distributor. The adjusting unit may also be arranged inside the ~~worm~~ screw body~~(~~, such as for example, an electric motor[[)]].

[00020] The adjusting device ~~is preferably~~may be arranged as an axial extension of the drum end in a ~~constructively simple and~~ space-saving manner in a discharge chamber which axially adjoins the ~~worm~~screw.

[00021] ~~In many applications, the~~The adjusting disk may also have recesses which ~~always~~ permit a defined [[~~"~~]]minimal passage[[~~"~~]] of solids. The recesses can be distributed on ~~the~~ an outer circumference~~; however~~. However, they may also be constructed in the manner of bores, slots or ~~the like, or, for example,~~ in a segment-type manner. The adjusting disk ~~is preferably plane but in various cases~~may be planar and may also have ~~a~~, for example, a curved construction.

[00022] The ~~invention is meaningfully supplemented by~~present disclosure also includes a computer-controlled control device for controlling the adjusting disk~~, particularly~~ as a function of the dry-substance content of the solids. ~~The~~ A numerical control or the control computer of the machine, which ~~nowadays~~ is often assigned to ~~the~~ centrifuges, can be shared for this purpose. This control can then act upon the adjusting unit.

[00023] ~~Additional advantageous further developments are contained in the subclaims.~~

[00024] ~~In the following, the invention will be explained by means of embodiments with reference to the drawing.~~Other aspects of the present disclosure will become apparent from the following descriptions when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[00025] Figure 1 is a sectional view of ~~a part of a first~~an embodiment of a solid bowl helical conveyor centrifuge according to the ~~invention;~~present disclosure.

[00026] Figure 2 is a sectional view of ~~a second~~another embodiment of solid bowl helical conveyor centrifuge according to the ~~invention analogous to Figure 1;~~present disclosure.

[00027] Figure 3 is a sectional view of ~~a third~~another embodiment of a solid bowl helical conveyor centrifuge according to the ~~invention analogous to Figure 1;~~present disclosure.

[00028] Figure 4 is ~~another~~ a sectional view of ~~the~~ an axial end of the solid bowl helical conveyor centrifuge ~~from~~ of Figure 1~~; and~~.

[00029] Figure 5 is a sectional view of ~~a fourth~~another embodiment of a solid bowl helical conveyor centrifuge, according to the ~~invention analogous to Figure 1~~present disclosure.

DETAILED DESCRIPTION

[00030] Figure 1 illustrates a solid bowl helical conveyor centrifuge with a machine housing 1 in which ~~the~~ a drum 3 is arranged which has a horizontal axis of rotation. A worm or screw 5 is arranged in the drum 3.

[00031] The drum 3 and the ~~worm~~ screw 5 each have an essentially cylindrical section 3a, 5a, respectively and a conically tapering section 3b, 5b, respectively, adjoining it. ~~The worm~~A screw blade 42 surrounds the cylindrical section 5a as well as the tapering ~~area~~ section 5b of the ~~worm~~ screw or of ~~the worm~~a screw body 29.

[00032] The drum 3 also has another cylindrical section 3c which adjoins the conically tapering section 3b and which defines a discharge chamber 15 whose diameter is smaller

than ~~the~~ a diameter of the cylindrical section 3a and ~~the~~ a diameter in the conical ~~part~~ section 3b of the drum 3.

[00033] An axially extending centric inlet pipe 7 is used for feeding ~~the~~ centrifuged material by way of a distributor 9 into ~~the~~ a centrifugal chamber 11 between the ~~worm~~ screw 5 and the drum 3.

[00034] When, for example, a sludgy mash in guided into the centrifuge, particles of solids are deposited on ~~the~~ a drum wall. A liquid phase forms farther toward ~~the~~ an interior of the drum 3.

[00035] The ~~worm~~ screw 5 is disposed on a bearing 13 and rotates at a slightly lower or higher speed than the drum 3 and delivers ~~the~~ centrifuged solids toward the ~~conical~~ conically tapering section 3b and beyond it to a cylindrical discharge chamber 15 in ~~the~~ a second cylindrical area, or section 3c, of the drum 3, ~~which~~. The cylindrical discharge chamber 15 adjoins the ~~worm~~ screw 5 in ~~the~~ an axial direction, ~~which drum~~. Drum 3, ~~in turn,~~ is provided with at least one discharge opening 17 for the solids leading radially toward ~~the~~ an outside of and from the drum 3.

[00036] In contrast, ~~the~~ liquid flows to ~~the~~ a larger drum diameter at ~~the~~ a rearward end of the cylindrical section 3a, 5a of the drum 3 and the liquid is discharged ~~there~~ at overflow openings 19 ~~with~~ the overflow openings 19 having an adjustable weir 21.

[00037] An adjusting device 25 is assigned to the at least one discharge opening 17 for the solids, which adjusting device 25 can be moved such that, by ~~means of it, the~~ use of the adjusting device 25, a cross-section of the discharge opening 17 is more or less cleared.

[00038] In ~~the second~~ cylindrical section 3c of the drum 3, the adjusting device ~~has~~ 25 includes an adjusting disk 25 which is arranged as an axial extension of the ~~worm and~~ screw 5. The adjusting disk 25 is axially displaceable ~~there~~ and rotates together with the ~~worm~~ screw 5 or is non-rotatably arranged relative to the ~~latter~~ screw 5.

[00039] The adjusting disk 25 ~~is~~ may be aligned perpendicular with respect to an axis of the drum ~~axis~~ and can be displaced axially below the discharge opening 17, which changes the available outlet cross-section of the discharge opening 17 for the solids. For implementing the displaceability, ~~its~~ an outside diameter of the adjusting disk 25 is adapted to ~~the~~ an inside diameter of ~~the second~~ cylindrical section 3c of the drum 3.

[00040] At least one ~~or more, particularly three~~ connecting ~~rod(s)~~rod 27 ~~is/are~~is fastened to the adjusting disk 25 ~~which are~~. The at least one connecting rod 27 is arranged perpendicular to the ~~latter~~ adjusting disk 25 and ~~which penetrate(s) the~~penetrates an axial end of ~~the worm~~screw body 29 of the ~~worm~~ screw 5 into a chamber 28 in ~~the~~ an interior of ~~the worm~~screw body 29~~, which chamber~~. Chamber 28 axially adjoins ~~the~~ a distributor 9 but is not connected with ~~it~~the distributor 9. The at least one connecting rod 27 may be two, three or more, as shown in Figure 4. The adjusting disk 25 may also include recesses 50 (see Figure 4) which permit a defined minimal passage of solids. The recesses 50 may be distributed on an outer circumference of the adjusting disk 25 and may be constructed in the form of boxes, slots, or in a segment-type manner.

[00041] ~~The~~ An end of the at least one connecting rod 27 facing away from the adjusting disk 25 is fastened to a ring 31 ~~(here, by means of~~, for example, screw nuts 23~~.), which~~ Ring 31 is disposed by ~~means of~~ a bearing 33 on a rod 35, which rod 35, during ~~the~~ an operation of the solid bowl helical conveyor centrifuge, does not rotate along with the ~~worm~~screw 5 or drum 3 but stands still and ~~which~~ centrically penetrates ~~the~~ an inlet pipe 7 in ~~the~~ an axis of rotation R of the solid bowl helical conveyor centrifuge.

[00042] As a result of the bearing 33, the adjusting disk 25, with the at least one connecting rod 27, can rotate together with the ~~worm~~ screw 5 during ~~the~~ operation of the centrifuge.

[00043] When the rod 35 is axially displaced ~~(~~, for example, by ~~means of~~ a ~~not illustrated~~ servo motor 52 located outside the drum 3~~,) together with it, also~~ the bearing 33, the ring 31, the at least one connecting ~~rod(s)~~rod 27 and thereby also the adjusting disk 25 are axially displaced which, in turn, changes the discharge cross-section opening 17 for the solids. The servo motor 52 may, for example, be one or more of the following: a) an electromotively operable adjusting unit, b) a hydraulic device, c) a pneumatic device and d) a computer-controlled control device (see Fig. 1).

[00044] According to Figure 1, the inlet pipe 7 does not ~~go along in the rotation~~rotate. In ~~the~~ a case of a ~~constructions with~~construction of an inlet pipe which does ~~go along in the rotation~~rotate (not shown ~~here~~), the bearing 13 can also be arranged outside the ~~decanter~~ ~~(~~centrifuge for rotary transmission[[~~)~~]].

[00045] According to ~~Figure 1~~the present disclosure, only a relatively low speed difference has to be mechanically overcome. Since ~~the~~ a transition from ~~the~~ stationary connecting

rod 35 ~~(connecting rod)~~ to the at least one ~~or more (particularly two or preferably three)~~ connecting ~~rods~~ rod 27 ~~preferably~~ rotating along with the ~~worm~~ screw 5 [[-]] ~~see Figure 4~~ [[–]]is arranged relatively close to ~~the~~ a center of the centrifuge or drum 3, only a relatively low speed difference has to be mechanically overcome.

[00046] Depending on ~~the~~ a construction of the decanter, or the centrifuge, the stationary connecting rod 35 ~~of~~ connected to the servo motor ~~(not shown)~~52 can be guided ~~in the manner of~~, as shown in Figure 1, through the feeding pipe 7 or, for example, as shown in ~~the manner of~~ Figure 3, through ~~the worm~~a screw drive shaft 41 to the non-rotatable ring 31. The at least one connecting ~~rods~~ rod 27 ~~are preferably~~is arranged on ~~the~~ an end situated opposite ~~the~~ a drive ~~(particularly~~54, for example, of the ~~worm~~ screw 5 and drum 3[[)]]. If the drive 54 were, for example, in Figure 2, arranged to the left of Figure 2 or on ~~the~~ a tapering end of the drum 3, the connecting ~~rods~~ rod 35 ~~are~~ would be guided ~~in a particularly surprising - but practical - manner~~ from ~~the~~ an opposite or cylindrical end of the drum 3 [[-]] ~~thus from the cylindrical end~~ [[-]] into ~~this~~ the drum 3. ~~This~~ The arrangement of the rod 35 is shown reversed in Figure 3, with respect to Figure 1.

[00047] Figure 2 differs from Figure 1 by ~~the~~ a manner of ~~the~~ operation of the adjusting disk 25.

[00048] According to Figure 2, the ring 31 does not run on a bearing but is used as a piston-type sliding element 39, which can be operated by a fluid~~, the~~. The rod 35 ~~being~~ is replaced by a pipe 37 which is used for ~~the~~ feeding and removing of the fluid, [[(]]for example, a hydraulic fluid such as water[[)]], into and out of ~~the~~ pressure chamber 48.

[00049] ~~The evacuation~~ Evacuation of the fluid can also take place by way of one or more bores in the ~~worm~~ screw body 29 (not shown).

[00050] ~~The~~ An axial position of the sliding element 39, and thus ~~the~~ a position of the adjusting disk 25, depends on the inflowing quantity of the adjusting fluid and on ~~the~~ a counteracting solids delivery force acting upon the adjusting disk 25, which delivery force also acts as a restoring force. The sliding element 39 is sealed off with O-rings 43 on ~~the~~ an interior wall of the cylindrical section 3a of the ~~worm~~ screw body 29 and on the pipe 37 and is axially displaceable.

[00051] Figure 5 shows ~~a variant with~~an embodiment having a swivellable adjusting disk 25, which ~~also~~ implements ~~the~~ a required axial mobility or displaceability with respect to

~~the worm end~~an end of the screw 5. By ~~means of~~ a shaft 45 or of a hinge (not shown), the adjusting disk 25 is swivellably linked to the axial ~~worm end, whereas, in turn, one or more of the~~ end of the screw 5. Whereas, the at least one connecting ~~rods~~ rod 27 ~~are~~ is linked to ~~the~~ a peripheral area of the adjusting disk 25~~facing away from the shaft 45~~. As a result, the cross-section of the solids discharge opening 17 available for the discharge of the solids can also be changed ~~in a simple manner~~. ~~This~~ The hinge (not shown) is ~~advantageously~~ situated opposite ~~the worm~~a screw opening at the end of the ~~worm~~screw 5.

[00052] Although the present disclosure has been described and illustrated in detail, it is to be clearly understood that this is done by way of illustration and example only and is not to be taken by way of limitation. The scope of the present disclosure is to be limited only by the terms of the appended claims.

[00053] List of Reference Numbers

Solid bowl helical conveyor centrifuge	1
drum	3
worm	5
cylindrical sections	3a, 3c, 5a
tapering sections	3b, 5b
inlet pipe	7
distributor	9
centrifugal chamber	11
bearing	13
discharge chamber	15
discharge opening for solids	17
overflow openings	19
weir	21
screw nuts	23
adjusting disk	25
connecting rod	27
chamber	28
worm body	29
ring	31
bearing	33
rod	35
pipe	37
sliding element	39
worm drive shaft	41
worm blade	42
O-rings	43
shaft	45
pressure chamber	48

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